In the Claims:

Please cancel all twenty-one currently pending claims without prejudice or disclaimer, and substitute the following new claims 22-37:

22. (New) An apparatus for determining the crank angle of an engine crankshaft, wherein the crankshaft rotates in a first direction and in a second direction, wherein the second direction is opposite to the first direction, the apparatus comprising:

indications located at predetermined angular intervals on the crankshaft, wherein each indication rotates integrally with the crankshaft along a path and passes near a detecting zone during crankshaft rotation;

a detector device for detecting the passage of the indications, the detector device being located in the vicinity of the path, wherein the detector generates at least two signals, the statuses of which vary between a first state and a second state as the indications pass by;

direction determining means for determining the statuses of the signals and for determining the rotation direction of the crankshaft on the basis of the statuses of the signals; and a control means for keeping a count based on the number of indications detected by the detector device and for controlling the engine based on the count.

23. (New) The apparatus according to claim 22 further comprising a counter for incrementing the count when the direction determining means determines that the crankshaft is rotating in the first direction and for decrementing the count when the direction determining means determines that the crankshaft is rotating in the second direction based on the number of indications detected by the detector device.

24. (New) The apparatus according to claim 22, wherein adjacent indications are equally spaced apart from one another by a first predetermined distance, and the detecting device includes a first detector and a second detector, wherein the first and second detectors are spaced apart by a distance that is less than the first predetermined distance.

25. (New) The apparatus according to claim 23 further comprising a rotor fixed to the crankshaft, wherein the indications are teeth formed on the rotor.

26. (New) The apparatus according to claim 23 further comprising: computing means for estimating the angle of the crankshaft based on the number of indications detected by the detector device; and

means for resetting the count after a full rotation of the crankshaft.

27. (New) The apparatus of claim 23, wherein nearly all adjacent indications are equally spaced apart from one another by a first predetermined distance, and the detecting device includes a first detector and a second detector, wherein the first and second detectors are spaced apart by a distance that is less than the first predetermined distance, and wherein the indications are arranged to include a gap that is wider than the first predetermined distance.

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28. (New) The apparatus according to claim 23 further comprising an electric control unit that serves as the direction determining means and the counter, wherein the electrical control unit is supplied with power for a predetermined time period after the engine is shut off.

29. (New) An apparatus for determining the crank angle of an engine crankshaft, wherein the crankshaft rotates in a first direction and in a second direction, wherein the second direction is opposite to the first direction, the apparatus comprising:

a set of indications located at predetermined angular intervals on the crankshaft, wherein each indication rotates integrally with the crankshaft along a path and passes near a detecting zone during crankshaft rotation;

a marking means for marking one location on the crankshaft;

a detector device for detecting the passage of the indications, the detector device being located in the vicinity of the path, wherein the detector generates at least two signals, the statuses of which vary between a first state and a second state as the indications pass by;

direction determining means for determining the rotation direction of the crankshaft based on the statuses of the signals;

a counter for keeping a count based on the number of indications detected by the detector device, wherein the counter increments the count when the direction determining means determines that the crankshaft is rotating in the first direction and for decrements the count when the direction determining means determines that the crankshaft is rotating in the second direction;

a reset means for detecting the passage of the marked location, wherein the reset means resets the count to a predetermined value when the marked location is detected; and a control means for controlling the engine based on the count.

30. (New) The apparatus according to claim 29, wherein nearly all adjacent indications are spaced apart from one another by a first predetermined distance, and the detecting device includes a first detector and a second detector, wherein the first and second detectors are spaced apart by a distance that is less than the first predetermined distance.

31. (New) The apparatus according to claim 29 further comprising:

a rotor fixed to the crankshaft; and

a plurality of teeth formed on the rotor, wherein the teeth are the indications, and wherein the teeth are arranged to include a gap that is wider than the first predetermined distance, and wherein the gap serves as the marking means.

32. (New) The apparatus according to claim 29 further comprising: computing means for estimating the angle of the crankshaft based on the number of indications detected by the detector device; and means for resetting the count after a full rotation of the crankshaft.

33. (New) A method of detecting the crank angle of an engine crankshaft, wherein the crankshaft rotates in a first direction and in a second direction, wherein the second direction is opposite to the first direction, the method comprising:

locating a plurality of indications at predetermined angular intervals on the crankshaft, wherein each indication rotates integrally with the crankshaft along a path and passes near a detecting zone during crankshaft rotation;

detecting the passage of the indications with a plurality of detectors, each detector being positioned at a different location;

generating a signal with each detector as the indications pass by the detectors, wherein the signals differ from one another in phase, and wherein each signal varies between a first state and a second state according to the proximity of an indication;

determining the rotation direction of the crankshaft on the basis of the statuses of at least a pair of the signals;

keeping a count of the number of indications detected by the detector device; and

a control means for controlling the engine based on the count.

34. (New) The method of claim 33 further comprising:

detecting an edge of one of the indications by detecting a change in the status of a first one of the signals; upon detecting an edge of an indication, determining the status of a second one of the signals; and

based on the statuses of the first and second signals, performing the step of determining the direction of rotation of the crankshaft.

35. (New) The method of claim 33 further comprising:

detecting a marked angular position of the crankshaft by comparing the statuses of the signals; and

setting the count to a predetermined value when the marked angular position is detected.

36. (New) The method of claim 33 further comprising the steps of: incrementing the count when it is determined that the crankshaft is rotating in the first direction; and decrementing the count when it is determined that the crankshaft is rotating in the second direction.

37. (New) The method of claim 35 further comprising the step of storing the current count value when the engine is shut off; and retrieving the stored count value as the current count value when the engine is restarted.

In the Abstract:

Please replace the Abstract in its entirety as follows:

--An apparatus for identifying a cylinder to be ignited in an engine. A plurality of teeth are formed on the periphery of the engine crankshaft. A sensor having two spaced detector parts senses the passage of the teeth. The detector parts identify the passage of a leading or a trailing edge of a tooth. An electronic control unit (ECU) determines the rotating direction of the crankshaft by comparing the signals from the two detector parts.

Further, the ECU keeps a count indicating the position of the crankshaft and controls the engine in accordance with the count. The apparatus remembers the position of the crankshaft when the engine stops to improve re-ignition.--.

Remarks

An early indication of allowable subject matter is respectfully requested.

The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 11-0600. Duplicate copies of this sheet are enclosed herewith

Dated: April 16, 1998

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